

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

ANALYSIS OF PROPOSED CELLULAR COMMUNICATION STANDARD, LARGE AREA SYNCHRONOUS CODE DIVISION MULTIPLE ACCESS

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Large area synchronous code-division multiple access (LAS-CDMA) is a proposed fourth generation cellular standard. Similar to cdma2000, the distinguishing feature of LAS-CDMA is the new set of spreading codes used to separate users in the wireless channel. This thesis examines the properties of the new spreading codes. Unlike Walsh functions, which are orthogonal only when perfectly synchronized, LAS-CDMA spreading codes are orthogonal when synchronized within a nine-chip interference-free time window. The interference-free time window allows LAS-CDMA to transmit the forward link and reverse link over the same frequency band. The primary LAS-CDMA data channels are examined in this thesis. LAS-CDMA uses a separate set of modulation and coding rate combinations for voice and data communications. Analysis of the effect of a tone jammer on the modulation and coding rate combinations is presented. Also, the ease with which LAS-CDMA can be intercepted is examined, and the security of LAS-CDMA is analyzed.

KEYWORDS: Code Division Multiple Access, Cellular Communication, Tone Jammer, Spread Spectrum Synchronization

SINGLE EVENT UPSET ELECTRON/HOLE RECOMBINATION IN SPAWAR SILICON-ON-INSULATOR PROCESS

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Silicon-on-Insulator (SOI) microelectronic devices exhibit less susceptibility to radiation damage in strategic environments. However, electron and hole recombination must be understood to properly validate circuit and device response to ionizing radiation. This thesis will validate the Silicon Dioxide (SiO_2) carrier transport parameters in the SPAWAR SOI process. By recreating the Harry Diamond Laboratory's simulation from April 1982 in the advanced SILVACO Simulation Tools, charge generation and recombination in SiO_2 will be investigated. Simulation results will be compared to previous published test data from the U.S Navy's Naval Postgraduate School and the U.S Army's Harry Diamond Laboratories to verify validity.

KEYWORDS: Si/ SiO_2 Carrier Transport Model, Silicon Electron/Hole Recombination, Silicon-on-Insulator Modeling, Oxide Yield, SPAWAR SOI Process

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CHARACTERIZATION CONSTANTS FOR FERROELECTRIC MEMORY CAPACITORS

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In this thesis, the classification of Perovskite material and their possible contributions as memory devices when composed within a capacitor like body is presented. Of special interest is the subclass of Ferroelectric material. The reason special focus is paid to ferroelectric is due to its ability to maintain a polarized state. It is therefore attempted to classify if such a material, when composed within a capacitor, actually holds the polarization state it was attempted to induce and then compare capacitors to one another to identify which polarized states may cause erroneous errors. These erroneous errors are due to the significantly small difference in capacitance levels between compared capacitors, therefore causing difficulties in identify a "1" or "0" state of imprinting. In attempting to classify polarization and capacitance differences two methods of identification were used, one through the use of the RT-66A stand alone computer to identify hysteresis curves, and the other a Rapid Pulse Capacitance Voltage (RPCV) electronic system, to compare simultaneous capacitors at different imprinted states.

KEYWORDS: Perovskite, Ferroelectrics, Polarization, Imprinting, Capacitance

A WAVELET-BASED PREDICTED TECHNIQUE FOR CONCEALMENT OF PACKET-LOSS EFFECTS IN WIRELESS CHANNELS

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In this thesis, a wavelet-based prediction method is developed for concealing packet-loss effects in wireless channels. The proposed method utilizes a wavelet decomposition algorithm in order to process the data and then applies the well known linear prediction technique to estimate one or more approximation coefficients as necessary at the lowest resolution level. The predicted sample stream is produced by using the predicted approximation coefficients and by exploiting certain sample value patterns in the detail coefficients. In order to test the effectiveness of the proposed scheme, a wireless channel based on a three-state Markov model is developed and simulated. Simulation results for transmission of image and speech packet streams over a wireless channel are reported for both the wavelet-based prediction and direct linear prediction. In all the simulations run in this work, the wavelet-based method outperformed the direct linear prediction method.

KEYWORDS: Linear Prediction, Wavelets, CELP, Denoising, Markov Channel

TWO-DIMENSIONAL MODELING OF ALUMINUM GALLIUM NITRIDE/GALLIUM NITRIDE HIGH ELECTRON MOBILITY TRANSISTOR

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Gallium Nitride (GaN) High Electron Mobility Transistors (HEMTs) are microwave power devices that have the performance characteristics to improve the capabilities of current and future Navy radar and communication systems. The Office of Naval Research (ONR) is funding research of developing GaN-

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based microwave power amplifiers for use in future radar systems. This thesis studies the effects of AlGa_N/Ga_N HEMTs' polarization, piezoelectric (PZ) and spontaneous, properties utilizing the commercially available Silvaco AtlasTM software for modeling and simulation. The polarization properties enhance the two-dimensional electron gas (2DEG) at the AlGa_N/Ga_N interface due to stress-induced polarization.

KEYWORDS: Aluminum Gallium Nitride, Gallium Nitride, High Electron Mobility Transistor, Piezoelectric Effect

ANALYSIS TECHNIQUES FOR IP SECURITY INTERNET KEY EXCHANGE PROTOCOL (U)

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(U) This thesis examines one of the solutions for security IP network traffic. Specifically it looks at the Internet Protocol Security (IPSec) architecture with an emphasis on the Internet Key Exchange (IKE) portion of the architecture. The goal of this thesis is to determine what aspects of IKE can be tested from the network interface on a commercial IPSec VPN device. The methodology used is one of experimentation, through the design and implementation of an IKE tool. This IKE tool is then used in the experimentation with commercial VPN products. The results show what this approach can accomplish, as well as the weaknesses of this approach.

KEYWORDS: Virtual Private Network (VPN), IKE, IPSec

COMPARISON OF CHANNEL EQUALIZATION FILTERING TECHNIQUES IN UNDERWATER ACOUSTIC COMMUNICATIONS

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In this thesis, underwater acoustic communications signal processing techniques, which are used to equalize the distortional effects associated with the ocean as a communications channel, are investigated for a shallow water ocean environment. The majority of current signal processing techniques employ a Finite Impulse Response (FIR) filter. Three equalization filters were investigated and presented as alternatives. They were the passive time-reversed filter, the inverse filter, and the Infinite Impulse Response (IIR) filter. The main advantage of the passive time-reversed filter and the inverse filter is simplicity of design. Bit error rates for the time-reversed filter were consistently around 10^{-1} and those for the inverse filter were greater than 10^{-1} . However, inability of the passive time-reversed filter to completely eliminate multipath components and the ill-conditioned nature of the inverse filter made it difficult to achieve Probability of Error results below 10^{-1} . Research into the development of an array receiver using a time-reversed filter should improve calculated bit error rates. Simulations of the IIR filter were conducted with limited success. The main advantage of an IIR filter is that fewer parameters are required in the design of the filter. However, the potential for instability in the filter is a significant limitation. Probability of Error results were found to be on the order of those for current FIR filters at close ranges. Unfortunately, instability issues arose for receivers as range from the source increased. This research on the IIR filter is still in the embryonic stage, whereas research using FIR filters is relatively highly developed. Further research is

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needed to address the issue of instability in IIR filters in order to make them an effective signal processing technique employable in underwater acoustic communications.

KEYWORDS: Underwater Acoustic Communications, Signal Processing, Infinite Impulse Response Filter

DELAY LOCK LOOP DISCRIMINATOR ANALYSIS

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With the emergence of flexible signal processing platforms, software defined radio is well on its way to becoming a viable reality, allowing the current signals intelligence system model to reduce reliance on custom hardware. To enable the pursuit of this goal software modules that simulate portions of digital communications systems must first be studied. In this thesis a candidate algorithm in the form of MATLAB code is presented in order to observe results in the discriminator characteristic of a non-coherent correlator, a portion of the delay lock loop, which performs the tracking portion of the synchronization process in a digital communication system. The digital communication system that is modeled is a direct sequence spread spectrum system.

KEYWORDS: Delay Lock Loop, Discriminator, Non-Coherent Correlation, S-curve, PN Sequence, Direct Sequence Spread Spectrum, AWGN, Integration Time

DENIAL OF SERVICE IN IEEE 802.11b WIRELESS LOCAL AREA NETWORKS

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The IEEE 802.11b wireless local area networking protocol is vulnerable to data exploitation techniques and denial of service attacks. The open-source nature of the standard allows malicious users to use valid frames to interrupt legitimate data transfer. This thesis demonstrates the use of frames from the IEEE 802.11 standard Medium Access Control protocol to deny legitimate users access to the medium. The use of valid IEEE 802.11b data frames and an RF Carrier at the channel center frequency were also investigated to determine the RF power level required to shut down the wireless network.

KEYWORDS: Wireless LAN, IEEE 802.11, IEEE 802.11b, Distributed Coordination Function, Medium Access, Denial of Service

ANALYSIS OF A PROPOSED THIRD GENERATION (3G) MOBILE COMMUNICATION STANDARD, TIME DIVISION – SYNCHRONOUS CODE DIVISION MULTIPLE ACCESS (TD-SCDMA)

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With a growing number of consumers utilizing the Internet, companies have foreseen a consumer demand for high-speed wireless access. Since current mobile cellular systems can transfer at most 115.2 kbps per user, a third generation of mobile cellular service has been under development by various organizations

since 1997. This new generation of technology will support data rates up to 2 Mbps for stationary mobiles and up to 144 kbps for vehicular traffic.

This thesis focuses mainly on TD-SCDMA, one of many candidates submitted to the International Telecommunications Union for third generation review. The standard, developed in China by the Chinese Academy of Telecommunications Technology, employs both code-division multiple access (CDMA) and time-division duplexing (TDD) to support both forward and reverse transmissions on one physical layer. This aspect, along with other common features of TD-SCDMA, will be studied and evaluated to determine if this new technology is a viable option for future commercial or military deployment.

KEYWORDS: Time Division Synchronous Code Division Multiple Access (TD-SCDMA), 3G Cellular Communications, Raised Root Cosine Filtering, CDMA, Orthogonal Variable Spreading Factor (OVSF), Time Division Duplexing (TDD)

ANALYSIS AND COST OPTIMIZATION OF A USCG REMOTE HYBRID POWER SYSTEM

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Analysis and simulations were performed to provide recommendations on how to improve the cost-effectiveness of the operation of remote hybrid power systems supporting various Alaskan National Distress System (NDS) communications sites. The study characterizes the loads and power sources at two NDS sites. Basic lead-acid battery theory is applied to produce a mathematical model to simulate the normal operation of the hybrid power system. Data from 2001 is analyzed to account for the effect of solar energy on the model. Results from the simulations indicate that a cost savings is realizable through improved hybrid controller settings.

KEYWORDS: Hybrid Power System, Lead Acid Batteries, USCG Alaskan National Distress System, Solar Energy, Cost Optimization

